
Exploring the Use of Next-Generation, Contactless Fingerprint Capture Identification Technology

What Is Contactless Fingerprint Biometrics?

- Innovative approach turns a smartphone into a high-quality, biometric-capture device.
 - **High-quality image capture – must be at 500 ppi +/- 2% max resolutions.**
 - **Image captured is processable through an AFIS/ABIS system for identity matching.**
 - **All fingers must be at optimum focus to allow accurate image rendering.**
- **A touchless fingerprint solution is only good if the image capture is sufficient enough to allow accurate post-processing to match legacy fingerprints collected through contact scanning. This is the most important parameter of any contactless fingerprint image capture product.**

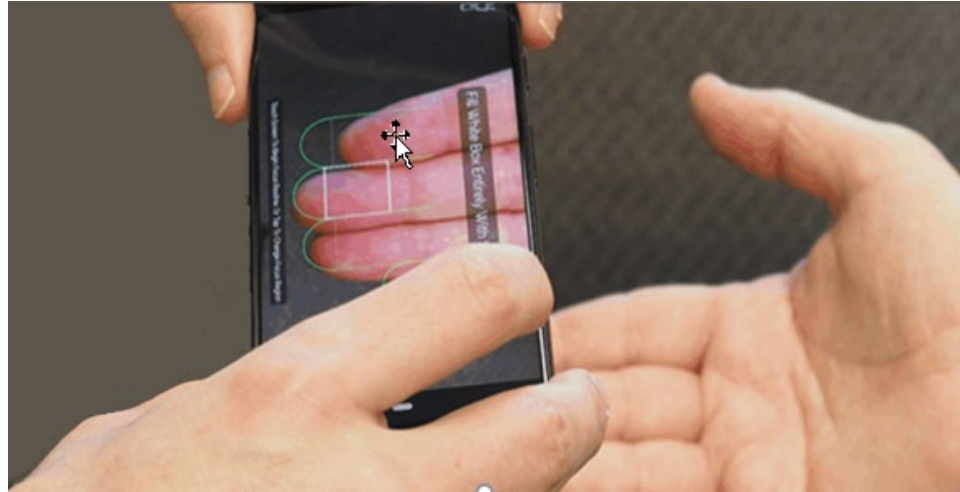
Turning Smartphones Into Fingerprint Capture Sensors

Enroll once...



CONTACT enrollment using an FBI, Appendix F-certified fingerprint scanner saved to ABIS/AFIS.

Identify forever...

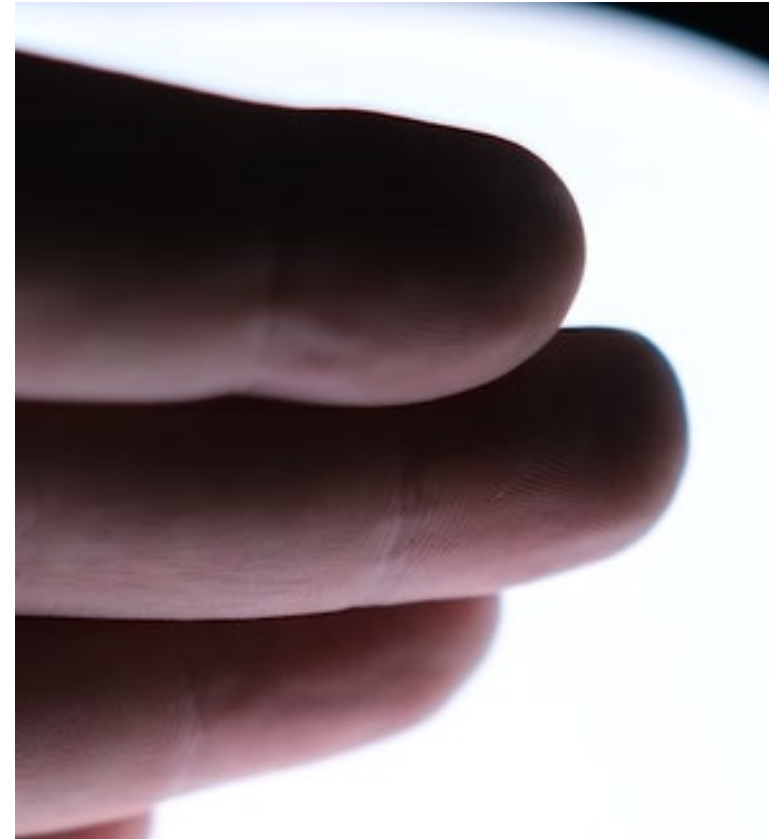


CONTACTLESS capture using app on a standard Android or IOS smartphone for identity matching.

Contact vs. Touchless Fingerprinting Image differences



Contact fingerprint images are created by pressing a curved fingerprint against a hard surface and collecting an image of the ridge structure that touches the surface. This turns a 3D fingerprint into a 2D image



Contactless images collect a picture of a finger (a 3d structure) and create from it a 2D image of the ridge structure. The center of the resultant image is similar to the same area on a contact print

Touchless Fingerprinting Image Quality

Contact



Contact "flat" print captured using scanner

Touchless



Touchless print captured by smartphone

Overlay



Overlay of contact print on touchless print
PROCESSABLE AREA

Mobile Biometrics in the DoD Today

- Current state of military mobile biometrics takes the form of dedicated custom devices that are both bulky and costly.
- Smartphones are ubiquitous, and adding the ability to collect high-quality, touchless fingerprints using their built-in cameras can make every soldier/officer a biometric sensor at low cost.
- Touchless fingerprint capture can also be added to existing custom biometric devices to add an additional search-only identification modality.

Benefits of Touchless Fingerprint Technology Properly Collected:

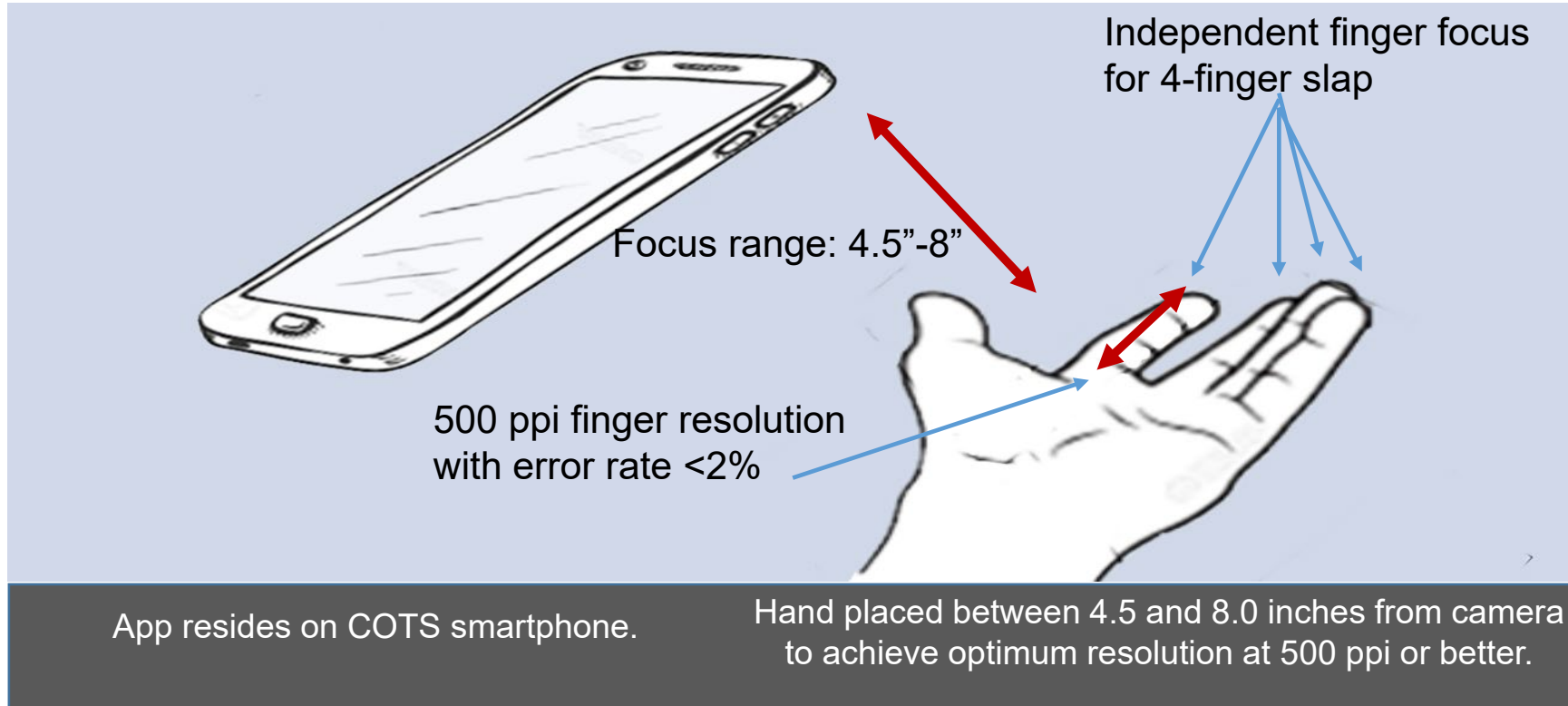
- Existing smartphones equipped with touchless collection allow every operator to have a fingerprint sensor at a low cost vs. traditional methods of using more expensive, dedicated, contact-based fingerprint scanner hardware.
- Since every soldier can have a sensor, fingerprinting becomes a viable identification option in those cases where a questioned individual cannot produce identity documents.
- Touchless fingerprinting does not require physical contact, enabling the soldier to maintain a physical separation from a suspect for both safety and health reasons.
- On-the-spot identification can permit soldiers to be more effective in dealing with minor offenses by reducing the number of times an individual needs to be physically taken to a collections facility for identity verification.
- The topic of “Spoofing Fake Fingers/Liveness” (“Fake Fingers”) is only an issue with self-enrollments. Soldiers can ascertain fake fingers/liveness when they are fingerprinting during encounters.
- Giving every soldier a touchless fingerprint sensor can streamline other forensic aspects of military intelligence work, such as the immediate capture of latent prints for sensitive site exploitation. (Coming)

Industry Challenge – Contactless Fingerprint Capture Using Smartphone

- Most smartphone contactless fingerprint solutions rely on the auto focus function built into the phone and, as a result, exhibit many critical issues:
 - **Distance measurements define resolution** and can have errors +/- 20% using native smartphone, while **AFIS/ABIS industry standard must be +/- 2%** for accurate matching resolution.
 - When capturing 4 fingers at a time (slap), only one finger will be at optimum focus.
 - The depth-of-field capture area is very narrow, which causes ease of use frustration and the need to recapture.
- Proper illumination during capture is required to overcome ambient lighting variation and shadowing effects.

Dynamic Range Algorithm Focus on the Fingers

Controlling the Camera



Native Camera

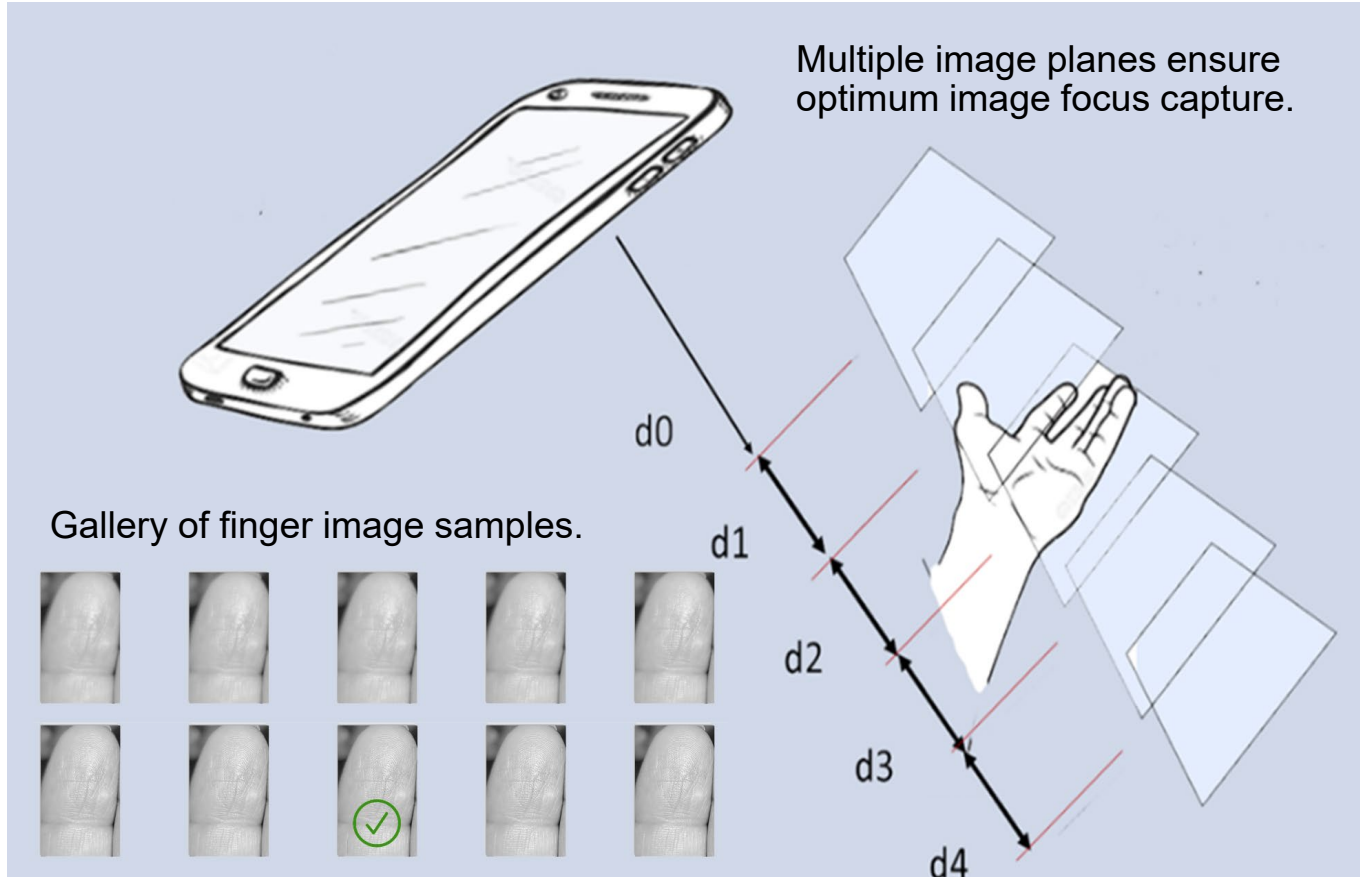


Biometrics App



Capture With Sharp Focus and Resolution

Multi-burst image capture method is the industry best approach at capturing multi-fingerprint simultaneous for optimum focus and resolution control.

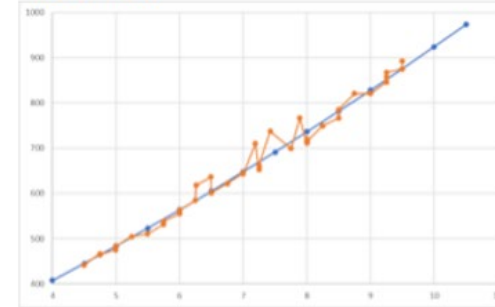


Calibration – Key to Overcoming Smartphone Intrinsic Camera Issue

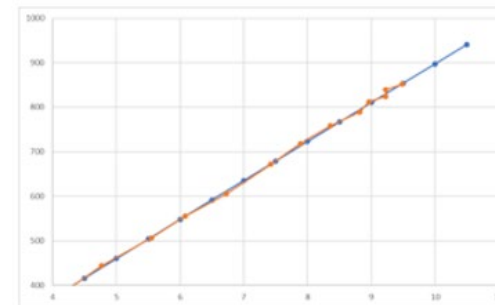
Challenge - This difference between what is reported by the camera and ground truth can be well over +/- 20%, which is certainly significant with industry standards, for matching is +/-2 percent or less.

- To overcome the intrinsic camera error, the algorithm presents a user-guided calibration routine.
- Calibration is only done once during initial setup.
- Process constructs an “Error Table” that equates the dimension reported by the camera against the known error for the camera’s specific distance measurements.
- When the nominal dimension is adjusted by the values in the error table for a particular distance, the result is an accurate value for the actual distance between the camera and the source (U.S. quarter).
- **The ultimate result of calibration makes available the true distance from the camera to the subject to calculate optimal image capture resolution.**

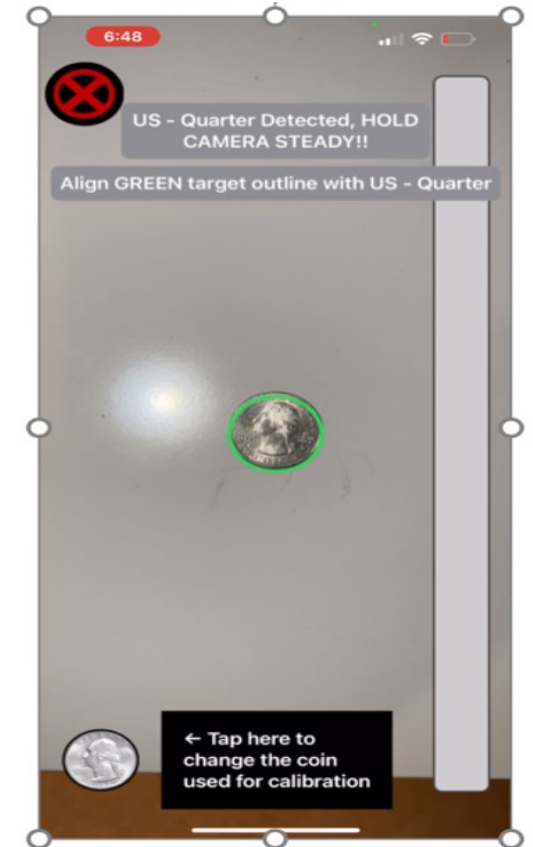
Inconsistent focus from uncalibrated camera—this is the original state of all cameras.



Consistent focus of calibrated camera—this is the result of our process.



Calibration technique using a target example U.S. quarter.



Other approaches to contactless fingerprinting Technology

- As stated, the accurate determination of the true distance between the camera lens and the Fingers being captured ultimately determines the resolution of the captured image (target is 500ppi +/- 2% to reliably match in legacy data bases such as DOD ABIS)
- There are many contactless technology providers currently on the market that use the auto-focus function of the phone as the primary means to determine distance. As stated, this can result in image resolution being off by 20% (400 to 600 dpi)
- When submitted to a legacy back end, the reliability of the match will be quite poor.
- If **non-standard matching algorithms** are used that are not minutia based, acceptable matching accuracy may be obtained via a proprietary back end solution. **Some competitors promote this concept.** Contactless images used for access control systems will most probably also use the proprietary matching algorithm and not be as sensitive to Image quality and resolution accuracy.

NIST sponsored mFIT Challenge

The focus of this challenge.....

is to build on current mobile fingerprint technologies or develop new technologies that are more efficient and cost effective than what is currently available. This technology will allow law enforcement officers to capture digital fingerprint data necessary to identify an individual who may not have proper identification without the officer having to carry additional equipment or transport an individual to a fingerprinting facility.

The challenge is on going now and results to be announced June 8

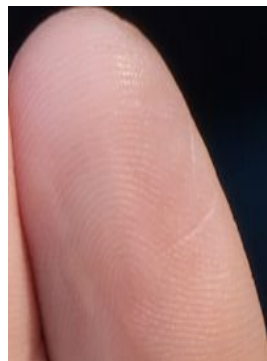
There are 6 finalists currently.

Future of Contactless Fingerprinting

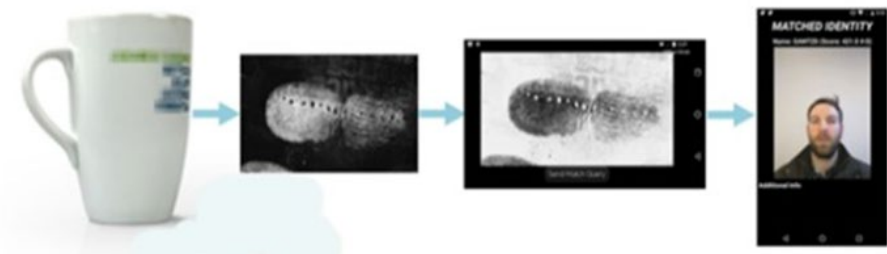
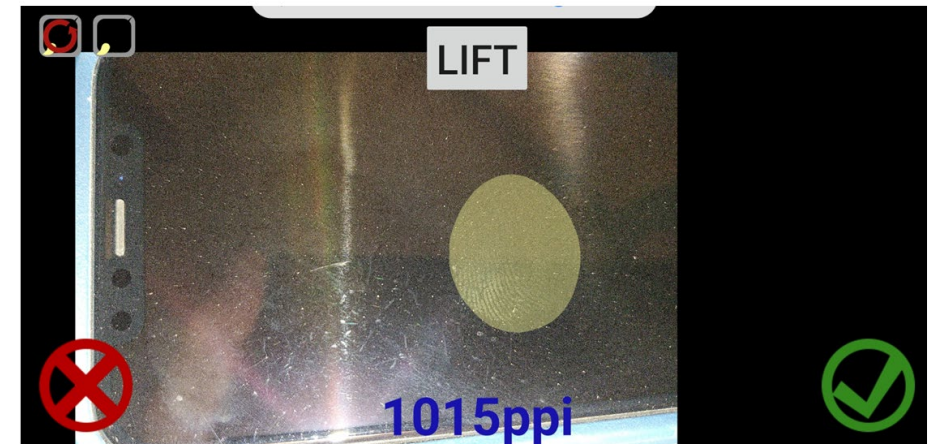
Contactless From > Distances

Current model smartphones have true telephoto lenses that can concentrate more on a distant object on the camera sensor than a standard lens.

Because they are true optical zoom lenses, telephotos can support afar fingerprinting where soldiers can maintain a safe distance from a suspect while obtaining prints. This capability is still a research activity, but initial results are very encouraging. Ultimately, fingerprinting should be possible at 2-3 meters, which provides a significant safety zone for soldiers in difficult situations.



Contactless - Latent Lifts



NIST Special Publication 500-334

Contactless Fingerprint Capture and Data Interchange Best Practice Recommendation

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U.S. Department of Commerce
Gina M. Raimondo, Secretary

National Institute of Standards and Technology
*James K. Olthoff, Performing the Non-Exclusive Functions and Duties of the Under Secretary of Commerce
for Standards and Technology & Director, National Institute of Standards and Technology*

Why This Best Practice Recommendation (BPR) Was Created

- NIST authorized this BPR document to remove resistance to trials using contactless images by suggesting the record format to allow its use with minimal impact to existing ABIS systems.
- NIST is encouraging the evaluation of this emerging technology so standards can be established for this “search only” modality. (Different from FBI appendix “F”)
- NIST recognizes the compelling advantages of using the high-quality cameras in today’s smartphones to collect fingerprint images for identification or verification purposes.
- By publishing this BPR, they are showing their support for its serious consideration as a new “search only” modality requiring its own standard.



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